

REMARKS

By the present amendment, claims 3-6 and 16-17 are pending in the application. Claims 16 and 17 are independent claims.

Claim Amendments

Independent claims 16 and 17 have been amended to delete reference to "bumps" to improve clarity and to make clear that the present invention is directed to metal balls adhesive bonded to and contacted with the electrodes.

New matter is not being presented by the amendment to independent claims 16 and 17.

Drawings

The Office Action in the Office Action Summary at Item 10 accepted the proposed drawing correction to Fig. 6B.

Enclosed is a replacement sheet for Fig. 6B.

§112, ¶1

Claims 3-6, 16 and 17 were rejected under 35 U.S.C. §112, first paragraph, as failing to comply with the written description requirement.

This rejection is respectfully traversed.

Applicants maintain that the operable sentence is at page 6, lines 17-18 of the specification which reads "A flux is preferably used for adhesive bonding the solder ball to the electrode." (Emphasis added). The instruction to one skilled in the art as to the preferred practice of the present invention is clear and unambiguous. A flux is the preferred embodiment for adhesive bonding the solder ball to the electrode. This sentence does not read - a flux plus

something else is preferably used for adhesive bonding the solder ball to the electrode --.

The Office Action maintains that the phrase **preferably used** doesn't mean **only**.

Applicants maintain that the sentence at page 6, lines 17-18 "a flux is preferably used for adhesive bonding the solder ball to the electrode" supports the claim limitation of independent claims 16 and 17 which reads -- wherein the metal balls are only adhesive bonded to the electrodes with a flux without reflowing--.

The position of the Office Action is that "preferably used" doesn't literally mean "only". Applicants maintain that literal support in the specification for a claim limitation is not the legal standard for the description requirement of the specification.

The CCPA discussed The Description Requirement Issue in In re Voss, 194 USPQ 267,271 (CCPA 1977). A copy of page 271 of In re Voss is attached.

In the left hand column of page 271 of In re Voss the CCPA stated under the heading The Description Requirement Issue:

It is only required, for example, that the specification describe the invention sufficiently for those of ordinary skill in the art to recognize that the applicant invented the subject matter he now claims.

The CCPA went on to state at page 271 of In re Voss:

The PTO has the initial burden of presenting evidence or reasons why those skilled in the art would not

recognize in the specification a description of the invention defined by the present claims.

The CCPA further stated at page 271 of In re Voss:

However, mere lack of literal support is not enough to carry the PTO's initial burden.

Literal support is not the legal standard.

The specification clearly discloses that the applicants invented as a preferred embodiment of their invention "a flux is preferably used for adhesive bonding the solder ball to the electrode".

It is submitted that from this disclosure one of ordinary skill in the art would recognize that the applicants invented the subject matter they now claim, i.e., "the metal balls are only adhesive bonded to the electrodes with a flux". There is no teaching in the specification that the applicants need something in addition to their preferred embodiment. The Office Action advances no evidence or reason why one skilled in the art would not recognize that the applicants only need their preferred embodiment to practice their invention.

The Office Action merely takes the position that preferably used does not literally mean only. The position taken in the Office Action is not the legal standard as set forth in In re Voss.

In view of the foregoing, it is respectfully requested that the rejection under 35 U.S.C. §112, first paragraph, be withdrawn.

§103

Claims 16 and 17 were rejected under 35 U.S.C. §103(a) as being unpatentable over Japan No. 06-333930 to Matsumoto in view of Japan No. 63-117450 to Okuaki and U.S. Patent No. 5,470,787 to Greer.

Claims 3-6 were rejected under 35 U.S.C. §103(a) as being unpatentable over Japan No. 06-333930 to Matsumoto in view of Japan No. 63-117450 to Okuaki and U.S. Patent No. 5,470,787 to Greer and further in view of U.S. Patent No. 5,656,863 to Yasunaga et al.

These rejections, as applied to the amended claims, are respectfully traversed.

Patentability

The present invention is directed to a semiconductor device in which spherical metal balls are adhesive bonded to and contacted with the electrodes of the device, as seen in the drawing of the attached Attachment A. Flux has, in general, a high viscosity and allows the metal ball to be securely held on the electrode and to be securely in contact therewith.

The device of the present invention ensures that the metal balls are subsequently reflowed in place (i.e., just on the electrodes) to form bumps to be used for the bonding with an object, such as a mounting substrate. If balls, which are not in contact with the electrodes, are reflowed, they are melted in a condition that they are floated on the flux which results in insufficient contact of the bumps formed with the electrodes.

Matsumoto (JP 6-333930) cited by the Office Action describes a method for adhering balls to electrodes through flux by rolling the balls on to a wafer. In other words, in Matsumoto, the ball is adhered to the electrode through flux provided on the electrode, and is not in direct contact with the electrode, as shown in the illustration of attached Attachment A.

Indeed, as set out in the English abstract of the Matsumoto reference, the ball "adheres" to a pad (electrode) due to flux. This does not mean that the ball is in direct contact with the pad (electrode). By tilting a wafer leftward and rightward to roll the balls thereon, the balls of Matsumoto are caught by the flux and only adhere to the surface of the flux, and do not come into contact with the electrode which is covered by the flux.

In the case in Matsumoto where the ball touches the flux, and passes over the flux without being caught thereby, part of the flux is transferred to the ball, and is then applied to a location on the wafer other than the electrode by the tilting of the wafer. Alternatively, the flux transferred to the ball can cause the ball to attach to another ball, and the two balls can adhere to one pad. In such a case, a device separated from the resultant wafer can suffer from failure.

Flux, in general, has a high viscosity, as referred to above. The contact of a rolling metal ball as small as on the order of 100 micrometers in diameter with flux allows the metal ball to adhere to the surface of the flux, but it is insufficient for the ball to come into direct contact with

the pad (electrode) covered by the flux. If the balls not in contact with the electrodes, such as in Matsumoto, as illustrated Attachment A, are reflowed, they are melted in the condition that they are floated on the flux, and do not fully wet the electrodes, leading to insufficient contact of the reflowed bumps with the electrodes.

As such, in Matsumoto, flux is used to catch and hold the rolled balls, and does not allow the balls to come into contact with the electrodes. In the present invention, flux is used to keep the metal balls mounted on the electrode in contact with the electrode. Such use of flux in the present invention is neither disclosed nor suggested in Matsumoto.

Okuaki (JP 63-117450A) relates to a method for providing reflowed bump electrodes having a uniform height. The method of Okuaki is directed to the mounting of a semiconductor device on a film carrier (TAB, Tape Automated Bonding), as referred to on the first page, the right column, lines 9 to 11. In Okuaki, the bump used is not spherical, and a flux is applied onto the bump (page 3, the upper right column, lines 13 to 16), and not between the bump and a semiconductor chip on which the bump is formed. The flux in Okuaki does not adhesive bond the bump to the semiconductor chip.

In the case of the present invention, the metal ball has not yet been reflowed and melted. The mounting process, to which the present invention is directed, is flip chip bonding, which is totally different from the mounting

process in Okuaki. The metal ball of the present invention, which is not reflowed, is adhesive bonded to the electrode with the flux.

Greer uses evaporation for the formation of bumps. The bump becomes a dome-like (ball-like) shape after reflowing. The bump of Greer is not bonded to an electrode of a chip with a flux. Thus, the technical idea of Greer is totally different from the present invention.

It is therefore submitted that the invention of independent claims 16 and 17 of the present application is not disclosed or suggested to a person of skill in the art from the disclosures of the three references cited by the Office Action.

It is therefore submitted that independent claims 16 and 17 are patentable over Matsumoto in view of Okuaki and Greer.

Since independent claims 16 and 17 are patentable, dependent claims 3 to 6 are also patentable.

CONCLUSION

It is submitted that in view of the present amendment and foregoing remarks, the application is now in condition for allowance. It is therefore respectfully requested that the present amendment be entered and the application, as amended, be allowed and passed to issue.

Respectfully submitted,

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process. Rather than include in his application a detailed discussion of how to prepare such known starting materials, appellant, for economy, referred the skilled artisan to Stookey '971. It is clear that appellant intended the "discussion of glass-ceramic materials and their production" in Stookey '971 to become part of his parent application. See *In re Lund*, 54 CCPA 1361, 1370, 376 F.2d 982, 989, 153 USPQ 625, 631 (1967). The board erred in finding otherwise.

The Description Requirement Issue

[5] Turning to the merits of the rejection, the PTO can rely on the French patent as a reference against the involved claims only if appellant's parent application does not comply with 35 USC 112, first paragraph with respect to those claims. How the application of the parent achieves compliance is immaterial. In *re Smith*, 481 F.2d 910, 178 USPQ 620 (CCPA 1973). It is only required, for example, that the specification describe the invention sufficiently for those of ordinary skill in the art to recognize that the applicant invented the subject matter he now claims. In *re Smythe*, 480 F.2d 1376, 1382, 178 USPQ 279, 284 (CCPA 1973). The PTO has the initial burden of presenting evidence or reasons why those skilled in the art would not recognize in the specification a description of the invention defined by the present claims. In *re Wertheim*, 541 F.2d 257, 191 USPQ 90 (CCPA 1976).

[6] As correctly pointed out by the Solicitor, the expression "at least 50%" crystal content does not literally appear in appellant's parent application. However, mere lack of literal support is not enough to carry the PTO's initial burden. In *re Wertheim*, supra at 265, 191 USPQ at 98. Nor is this a situation where the claims read on embodiments outside the scope of the description.¹³ Appellant's parent application describes the invention in terms broader than those in the claims, for example:

I have further found that a glass-ceramic material containing a lithium-aluminum-silicate crystal phase identified as beta-spodumene can be strengthened to a remarkable degree by ion exchange resulting from thermochemical treatment. Strangely enough, however, this strengthening capability is

of a selective nature, that is peculiar to, and uniquely associated with, certain crystals or crystal structure. Thus, it has been found that a glass-ceramic containing a metastable beta-eucryptite crystal phase is not strengthened by such ion exchange whereas the same material after thermal conversion of the crystal phase to the beta-spodumene form is readily strengthened.

The term "beta-spodumene" has been used to designate a crystal that is now known to be in the * * * tetragonal system. * * *

* * * the basic considerations for strengthening of this type of glass-ceramic material appear to be the presence of an exchangeable ion (lithium) in the crystal, a crystal in the tetragonal system, and a fine grain size crystal characteristic of well-developed glass-ceramic materials.

It is apparent that appellant contemplated that his invention resided in the use of a well-developed glass-ceramic material having beta-spodumene as the crystal phase to enable strengthening of the material by his ion exchange process. The claims on appeal add only the further recitation that such glass-ceramic materials must have a crystal content of "at least 50% by weight."

[7] Appellant urges that this 50% limitation merely quantifies the percentage crystal content inherent in use of the term "glass-ceramic material." In determining the meaning of that expression, as used in the context of the present application, we must look to the art or technology to which the subject matter pertains. In *re Salem*, F.2d , 193 USPQ 513 (CCPA 1977).

In this case, appellant has incorporated the Stookey '971 discussion of "glass-ceramic materials" into his application. He also points to the fact that, in litigation involving Stookey '971, the District Court for the District of Delaware made findings of fact, subsequently approved by the Third Circuit Court of Appeals, in *Corning Glass Works v. Anchor Hocking Glass Corp.*, 253 F.Supp. 461, 149 USPQ 99 (D. Del. 1966), modified, 374 F.2d 473, 153 USPQ 1 (CA 3 1967), substantially as follows:

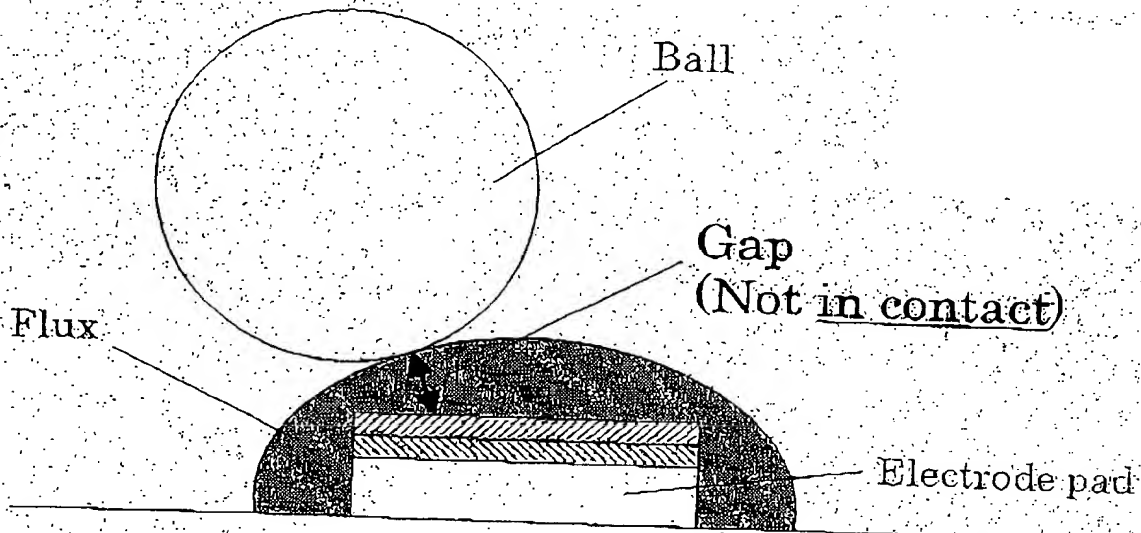
(1) the change in properties in a glass ceramic begins at approximately 40% crystallinity and in most cases is complete at 60% crystallinity, (2) the 50% crystallinity limitation found in all claims of the Stookey '971 patent must be read in light of the patent's overall purpose to

¹³ See the treatment of claims 1 and 4 in *In re Wertheim*, supra at 263-64, 191 USPQ at 97-98.

ATTACHMENT A

BEST AVAILABLE COPY

MATSUMOTO - No contact of ball with electrode



THE INVENTION - Ball in contact with electrode

